MYCOTAXON

*Volume 111, pp. 1–10* *January–March 2010*

# Conidial fungi from the semi-arid Caatinga biome of Brazil. New species of *Endophragmiella* and *Spegazzinia* with new records for Brazil, South America, and Neotropica

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**Abstract —** Two new species found on dead bark and fruit in Brazilian semi-arid region are described and illustrated. *Endophragmiella tuberculata* sp. nov. is characterized by obovoid, 1-septate, verrucose conidia, and can be distinguished from similar *Endophragmiella* species by the distal cells of its conidia with conspicuous tubercules. *Spegazzinia flabellata* sp. nov. has two types of conidia: *a*—globose to subglobose, simple, strong spinulose and *b*—co-planate, with four quadrangular cells, finely spinulose; it can be separated from earlier described *Spegazzinia* species by *a*-type conidia with conspicuous spines. *Dictyoarthrinium sacchari* is reported for the first time from Brazil. Furthermore, *E. collapsa* and *E. dimorphospora* are new records for Neotropica and South America respectively.

**Key words** — hyphomycetes, anamorphic fungi

## Introduction

The genus *Endophragmiella* B. Sutton was proposed to accommodate two hyperparasitic species, *E. pallescens* B. Sutton (type species) and *E. canadensis* (Ellis & Everh.) B. Sutton (Sutton 1973). Presently, 75 species and one variety are accepted and distributed from temperate to tropical regions (Wu & Zhuang 2005). The genus is characterized by macronematous, mononematous conidiophores with integrated conidiogenous cells, proliferating percurrently and solitary euseptate or distoseptate conidia with rhexolitic secession (Sutton 1973, Hughes 1979). Four species have previously been reported from Brazil, viz. *E. fasciata*, *E. boewei*, *E. quadrilocularis* and *E. rigidiuscula* (Castañeda-Ruiz 1988, Gusmão et al. 2001, Marques et al. 2008, Leão-Ferreira et al. 2008).

However, *E. fasciata* R.F. Castañeda has been reassigned to *Repetophragma* as *R. fasciatum* (R.F. Castañeda) R.F. Castañeda, et al. (Castañeda-Ruiz et al. 2006).

Few genera of conidial fungi – *Arthrinium* Kunze, *Catenospegazzinia* Subram., *Cordella* Speg., *Dictyoarthrinium* S. Hughes, *Endocalyx* Berk. & Broome, *Pteroconium* Sacc. ex Grove, and *Spegazzinia* Sacc., representing approximately 45–50 species – have conidiophores arising and elongating from a cup-shaped cell called a conidiophore mother cell or a basauxic conidiophore (Hughes 1953, Somrithipol 2007). These genera are distinguished by the conidiogenous loci, the occurrence of setae and stroma, and the septation of conidia and conidiophores (Somrithipol 2007). According to the Index Fungorum database (www.indexfungorum.org), 23 species are clustered in the genus *Spegazzinia*, characterized by basauxic conidiophores and smooth, roughened or with conspicuous spiny, brown to dark brown conidia (Chen & Tzean 2000). The conidia of *Spegazzinia* are produced at the on apex of a basauxic filament and are usually two types, *a* and *b;* the *a* conidia are usually globose to subglobose, spinulose; the *b* conidia are multicellular, muriform, variously shaped, and usually smooth (Mercado-Sierra 1984).

## Materials and methods

The region of "Serra do Ramalho" (13º30'S; 44º15'W), is one of the 27 areas of high biological importance for the Caatinga biome, and is very representative vegetation of the semi-arid region in Northeast of Brazil. This area occupies about 2000 km², within the municipalities Cariranha, Coribe, Feira da Mata, Serra do Ramalho, Cocos and São Félix do Coribe (Ministério Da Integração Nacional 2005). The "Serra do Ramalho" region is characterized by presence of calcareous rock, and the altitude rises from 600–800 m, with annual rainfall up to 1,500 mm (Moreno 2006). Field expeditions were made in November 2007 and February 2008 in Coribe, São Félix do Coribe and Serra do Ramalho. Leaf litter samples were placed in separate paper bags by locality and taken to the laboratory. The samples were placed in Petri dishes, which were placed inside polystyrene containers (150 L) with 200 mL of sterile water plus 2 mL of glycerol and incubated at room temperature (Castañeda-Ruiz 2005). Samples were examined at regular intervals for the presence of conidial fungi. Fungal structures were placed in polyvinyl alcohol on a microscope slide and preserved on dry substrates. All specimens are deposited in the Herbarium of Universidade Estadual de Feira de Santana (HUEFS).

## Taxonomy

***Endophragmiella tuberculata*** S.M. Leão & Gusmão, **sp. nov.**

MycoBank MB515068 Figs. 1–7

*Coloniae effusae, brunneae. Mycelium partim immersum, partim superficiale, ex hyphis septatis, ramosis, laevibus, pallide brunneis. Conidiophora macronemata, mononemata, recta vel flexuosa, erecta, simplicia vel ramificata, septata, laevia, brunnea, 12–106 × 3.5–5.5 µm. Cellulae conidiogenae monoblasticae, terminales et intercalares*

Figures 1–7: *Endophragmiella tuberculata* (from the holotype *HUEFS 136870*). 1–2. General aspect. 3. Detail of the percurrent proliferation (arrow). 4–5. Young conidia. 6. Detail of the rhexolytic secession of conidia (arrow). 7. Detail of the tubercules (arrow). (Bars = 10 μm)

*in conidiophoris incorporatae, cum proliferationibus percurrentes, cylindricae, laeviae, pallide brunneae.* Secessio conidiorum *rhexolitica.* Conidia *solitaria, acrogena, 1-septata, obovoidea, verrucosa, simplicia, sicca, ad cellula basalis 6–7μm, cellula apicalis 8.5–12 μm, tuberculata, pallide brunnea, 14.5–19 × 10.5–18.5 μm.* Teleomorphosis *ignota.*

*Holotypus: BRAZIL Bahia: Coribe, in corticis emortuis, 19.III.2008, leg. S.M. Leão-Ferreira, HUEFS 136870.*

Etymology: Latin, *tuberculatus* – in reference to the presence of tubercules on the conidia.

Conidiophores, macronematous, mononematous, straight or flexuous, erect, simple or branched, septate, smooth, brown, 12–106 × 3.5–5.5 µm. Conidiogenous cells monoblastic, terminal or intercalary, integrated, with conspicuous percurrent proliferations, cylindric, smooth, pale brown. Conidial secession rhexolytic. Conidia solitary, acrogenous, 1-septate, obovoid, verrucose, simple, dry, basal cells 6–7 µm long, apical cells 8.5–12 µm long, tuberculate, pale brown, 14.5–19 × 10.5–18.5 µm. Teleomorph unknown.

Notes: Among the described *Endophragmiella* species only two — *E. dingleyae* S. Hughes (Hughes 1978a) and *E. unisetulata* (Matsush.) S. Hughes (Hughes 1979) — resemble *E. tuberculata* in conidial ornamentation. However, *E. dingleyae* and *E. unisetulata* differ in their conidial morphology (spherical, 0-septate and obclavate, 2-septate, respectively).

Five species have been described as having obovoid, smooth, 1-septate conidia: *E. globulosa* (B. Sutton) S. Hughes (Hughes 1978c), *E. pinicola* (M.B. Ellis) S. Hughes (Hughes 1979), *E. resinae* P.M. Kirk (Kirk 1981), *E. taxi* (M.B. Ellis) S. Hughes (Hughes 1979), and *E. uniseptata* (M.B. Ellis) S. Hughes (Hughes 1979). The apical conidial cells of *E. taxi*, *E. uniseptata,* and *E. pinicola* are larger than in *E. tuberculata.* Although *E. globulosa* produces similarly shaped conidia, it can be separated from *E. tuberculata* by its discolored conidia. *Endophragmiella resinae* somewhat resembles *E. tuberculata,* but the obovoid to pyriform conidial shape of *E. resinae* is quite distinctive. The new species is named *E. tuberculata* for its peculiar conidial ornamentation.

***Spegazzinia flabellata*** S.M. Leão & Gusmão, **sp. nov**.

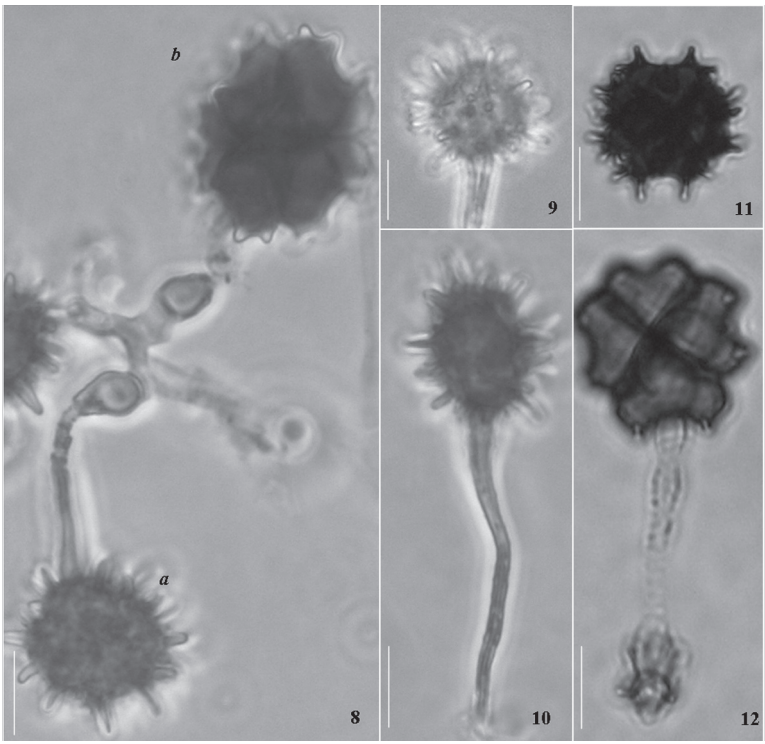
MycoBank MB515069 Figs. 8–12

*Mycelium plerumque in substrato immersum, ex hyphis septatis, ramosis, laevibus, pallide brunneis. Cellula matricales conidiophori cupulate vel lageniformis, pallide brunnea vel brunnea, 5–7 × 4–5 µm. Conidiophora macronematosa, mononematosa, basauxica, simplia, recta vel flexuosa, basim pallide brunnea, apicem brunnea, 8–42 × 2–3 µm. Cellulae conidiogenae monoblasticae, terminales, in conidiophoris incorporatae. Secessio conidiorum rhexolitica. Conidia solitaria, simplicia, brunnea vel atro-brunnea, duorum generum: a) globosa vel subglobosa, 4-cellulare, spinulosus, brunneae vel atro-brunnea, 11–14 × 8–16 µm; spinis 1.5–4 µm longis; b) coplanata, quadrangularis, 4-cellulare, cruciatus septata, latere lobatis irregularis, laeviae vel minute spinulosus, 15–18 × 13–18 µm. Teleomorphosis ignota.*

*HOLOTYPUS: BRAZIL. Bahia: Coribe, in fructus emortuis, 16.III.2008, leg. S.M. Leão-Ferreira, HUEFS 136875.*

Etymology: Latin, *flabellatus* – in reference to the conidial morphology.

Conidiophores macronematous, mononematous, basauxic, simple, straight or flexuous, smooth, pale brown, 8–42 × 2–3 µm, arising from cupuliform




Figures 8–12. *Spegazzinia flabellata* (from holotype *HUEFS 136875*). 8. General aspect, with two kinds of conidia *a* and *b*. 9–10. Type *a* conidia. 11–12. Type *b* conidia.
(Bars = 10μm)

to lageniform, unbranched mother cells, 5–7 × 4–5 μm. Conidiogenous cells monoblastic, terminals, integrated. Conidial secession rhexolytic. Conidia solitary, with two kinds: type-*a*, globose to subglobose, 4-celled, with conspicuous scattered spines, brown to dark brown, 11–14 × 8–16 μm; spines 1.5–4 μm long; type-*b*, co-planate, 4-celled, cruciately septate, quadrangular, irregularly lobed, smooth or finely spinulose, brown to dark brown, 15–18 × 13–18 μm. Teleomorph unknown.

Notes: A thorough survey of literature reveals that only *Spegazzinia lobulata* Thrower (McLennan et al. 1954) and *S. sundara* Subram. (Subramanian 1971) resemble *S. flabellata* in producing two types of conidia with lobate type-*b* conidia (Table 1, p. 6). The conidia are smooth type-*b* in *S. lobulata* and larger and irregularly lobate in *S. sundara* (Chen & Tzean 2000, Ellis 1976). *Spegazzinia flabellata* differs from these species by the presence of delimited

Table 1. Synopsis of the species related to *Spegazzinia flabellata*

| Species | type-*a* conidia | | type-*b* conidia | |
|---|---|---|---|---|
| | Diam. (µm) | Spines (µm) | Diam. (µm) | Spines (µm) |
| *S. flabellata* | 11–14 | 2–4 | 15–18 | 1.5–4 |
| *S. intermedia* | — | — | 18–28 | absent |
| *S. lobulata* | 20 | 12 | 17–22 | absent |
| *S. sundara* | 10–30 | 9–12 | 17–25 | inconspicuous |

lobes and spines on the type-*b* conidia. *Spegazzinia intermedia* M.B. Ellis has type-*b* conidia similar to those of *S. flabellata* but does not produce type-*a* conidia (Ellis 1976).

***Dictyoarthrinium sacchari*** (J.A. Stev.) Damon, Bull. Torrey bot. Club 80: 164. 1953. Figs. 13–16

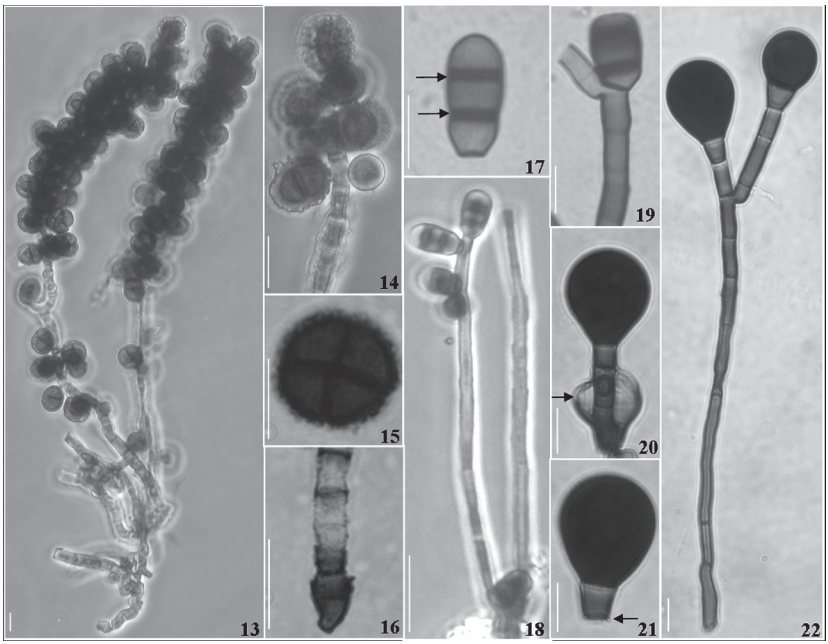
≡ *Tetracoccosporium sacchari* J.A. Stev., J. Dept. Agric. Porto Rico 1: 225. 1917.

Conidiophores macronematous, mononematous, basauxic, simple, straight or flexuose, septate, smooth, hyaline, 45–240 × 4.5–6 µm, arising from a cupuliform, unbranched, verrucose, mother cell, 3–7 × 3.5–4.5 µm. Conidiogenous cells polyblastic, terminals, intercalary, integrated, cylindric, verrucose. Conidial secession schizolytic. Conidia solitary, cruciately septate, quadrangular to subspherical, dry, verrucose, brown, 9–15 µm diam., 7–9 µm wide.

Specimens examined: BRAZIL. Bahia: São Félix do Coribe, on decaying leaves of unidentified dicotyledon, 11.XII.2007, coll. S.M. Leão-Ferreira, HUEFS 136891; Serra do Ramalho, on dead bark of unidentified dicotyledon, 7.I.2008, coll. S.M. Leão-Ferreira, HUEFS 136892; on dead flower of unidentified dicotyledon, 11.I.2008, coll. S.M. Leão-Ferreira, HUEFS 136893; Coribe, on decaying fruit of unidentified dicotyledon, 7.III.2008, coll. S.M. Leão-Ferreira, HUEFS 136894.

Distribution: Cuba, Ghana, India, Malaysia, Puerto Rico, Solomon Islands, Venezuela, Zambia (Ellis 1971, Matsushima 1971, Mena-Portales & Mercado-Sierra 1987, Mercado-Sierra 1980, 1984)

Notes: *Dictyoarthrinium* is distributed worldwide (Kirk et al. 2001) and comprises seven species. It is characterized by mononematous or synnematous conidiophores with integrated conidiogenous cells and septate conidia (Somrithipol 2007). *Dictyoarthrinium africanum* S. Hughes (Hughes 1952), has 16-celled conidia; however the other six species have cruciately septate 4-celled conidia (Somrithipol 2007). *Dictyoarthrinium rabaulense* Matsush. (Matsushima 1971) and *D. synnematicum* Somrith. (Somrithipol 2007) differ from *D. sacchari* in conidial diameter and synnematous conidiophores, respectively. *Dictyoarthrinium lilliputeum* P. Rag. Rao & D. Rao and *D. microsporum* P. Rag. Rao & D. Rao (Rao & Rao 1964) possess conidiophores and conidia smaller than those of *D. sacchari* (Somrithipol 2007). The conidiophores in our examined material are larger than those species reported




Figures 13–16: *Dictyoarthrinium sacchari*. 13. General aspect. 14. Basauxic development 15. Conidium.. 16. Conidiophore mother-cell.;

Figures 17–19. *Endophragmiella collapsa*. 17. Conidium. 18. General aspect. 19. Detail of the proliferation;

Figures 20–22. *Endophragmiella dimorphospora*. 20. Detail of the cup. 21. Conidium with detail of rhexolytic secession. 22. General aspect

(Bars = 10μm)

in the literature (Ellis 1971, Matsushima 1971, Mercado-Sierra 1984). This is the first record for Brazil.

***Endophragmiella collapsa*** (B. Sutton) S. Hughes, Fungi Canadenses (Ottawa): no. 126. 1978. Figures 17–19

= *Endophragmia collapsa* B. Sutton, Mycological Papers 132: 54. 1973.

Conidiophores macronematous, mononematous, simple or branched, straight or flexuous, septate, smooth, brown, 100–236 × 3–5 μm. Conidiogenous cells monoblastic, terminal, integrate, cylindric, percurrent proliferation, pale brown. Conidial secession rhexolytic. Conidia solitary, ellipsoid to ovoid, 2-septate, brown at septa, simple, dry, basal cell hyaline to pale brown, apical cell dark brown, frequently colapsed, 14–17 × 7–9 μm.

Specimens examined: BRAZIL. Bahia: Coribe, on dead bark of unidentified dicotyledon, 6.I.2008, coll. S.M. Leão-Ferreira. HUEFS 136880.

Distribution: Canada, former Czechoslovakia (Holubová-Jechová 1986; Sutton 1973).

Notes: Among the species with ellipsoid and 2-septate conidia, *E. biseptata* (Peck) S. Hughes (Hughes 1978b), *E. hughesii* D. Hawksw. (Hawksworth 1979), and *E. oblonga* (Matsush.) S. Hughes (Hughes 1979) all possess conidia larger than those in *E. collapsa.* According to Holubová-Jechová (1986), Hughes (1979), and Sutton (1973), the important diagnostic character for *E. collapsa* is the typically collapsed basal conidial cell. The Brazilian specimen has larger conidiophores than previously described material, and the conidial septa are also thicker and darker. This is the first record for Neotropica.

***Endophragmiella dimorphospora*** (Awao & Udagawa) S. Hughes, N.Z. J. Bot. 17: 149. 1979. Figs. 20–22

= *Endophragmia dimorphospora* Awao & Udagawa, Trans. Mycol. Soc. Japan 15: 99. 1974.

Conidiophores macronematous, mononematous, simple or branched, straight or flexuous, septate, smooth, brown, 28–273 × 3–4.5 µm. Conidiogenous cells monoblastic, terminal, integrate, percurrent proliferation, cylindric, smooth pale brown. Conidial secession rhexolytic. Conidia solitary, 1-septate, obclavate, simple, smooth, basal cell pale brown, with truncate base, apical cell dark brown, 19.5–31 × 13.5–19.5 µm.

Specimens examined: BRAZIL. Bahia: São Félix do Coribe, on decaying twig of unidentified dicotyledon, 20.XII.2007, coll. S.M. Leão-Ferreira. HUEFS 137808.

Distribution: Australia, Cuba, Hong Kong, Japan, Kenya, Mexico, Republic of Mauritius, Taiwan, USA (Caretta et al. 1999, Castañeda-Ruiz et al. 1998, Dulymamode et al. 2001, Farr & Rossman 2008, Heredia et al. 1997, Hughes 1979, Matsushima 1980, 1989).

Notes: *Endophragmiella dimorphospora* has been collected from soil, leaf litter, and other plant materials (Farr & Rossman 2008, Heredia et al. 1997). *Endophragmiella biconstituta* (Rambelli) Matsush., *E. globulosa,* and *E. resinae* are other species with 1-septate, smooth conidia with the apical conidial cell 1.5–3 times larger than the basal cell (Hughes 1978c, Kirk 1985, Wu & Zhuang 2005). *Endophragmiella biconstituta* differs in its obpyriform to subglobose and dark brown conidia while *E. globulosa* and *E. resinae* have hemispheric basal conidial cells. The material examined has larger conidia than species described in Hughes (1979), Heredia et al. (1997), and Matsushima (1975). This is the first record for South America.

## Acknowledgements

The authors thank Dr P.M. Kirk (CABI, UK) and Dr Xiu-Guo Zhang (Shandong Agricultural University, China) for preview review this paper. We extend grateful to "Programa de Pós-Graduação em Botânica da Universidade Estadual de Feira de Santana (PPGBot/UEFS)" and CAPES. This study was party supported by Program of Research

of Biodiversity in the Brazilian Semi-arid (PPBIO Semi-arido/Ministry of Technology and Sciense). The second author thanks CNPq (Proc. 474589/2008-0).

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